

**BS EN ISO 4892-1:2016**



**BSI Standards Publication**

# **Plastics — Methods of exposure to laboratory light sources**

Part 1: General guidance (ISO 4892-1:2016)



**National foreword**

This British Standard is the UK implementation of EN ISO 4892-1:2016. It supersedes BS EN ISO 4892-1:2001 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee PRI/21, Testing of plastics.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Published by BSI Standards Limited 2016

ISBN 978 0 580 76665 7

ICS 83.080.01

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This British Standard was published under the authority of the Standards Policy and Strategy Committee on 31 May 2016.

**Amendments/corrigenda issued since publication**

| Date | Text affected |
|------|---------------|
|------|---------------|

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English Version

Plastics - Methods of exposure to laboratory light sources -  
Part 1: General guidance (ISO 4892-1:2016)

Plastiques - Méthodes d'exposition à des sources  
lumineuses de laboratoire - Partie 1: Lignes directrices  
générales (ISO 4892-1:2016)

Kunststoffe - Künstliches Bestrahlen oder Bewittern in  
Geräten - Teil 1: Allgemeine Anleitung (ISO 4892-  
1:2016)

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EUROPÄISCHES KOMITEE FÜR NORMUNG

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## European foreword

This document (EN ISO 4892-1:2016) has been prepared by Technical Committee ISO/TC 61 “Plastics” in collaboration with Technical Committee CEN/TC 249 “Plastics” the secretariat of which is held by NBN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by November 2016, and conflicting national standards shall be withdrawn at the latest by November 2016.

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### Endorsement notice

The text of ISO 4892-1:2016 has been approved by CEN as EN ISO 4892-1:2016 without any modification.

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## Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see [www.iso.org/directives](http://www.iso.org/directives)).

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 61, *Plastics*, Subcommittee SC 6, *Ageing, chemical and environmental resistance*.

This third edition cancels and replaces the second edition (ISO 4892-1:1999), which has been technically revised.

ISO 4892 consists of the following parts, under the general title *Plastics — Methods of exposure to laboratory light sources*:

- *Part 1: General guidance*
- *Part 2: Xenon-arc lamps*
- *Part 3: Fluorescent UV lamps*
- *Part 4: Open-flame carbon-arc lamps*

## Introduction

Plastics are often used outdoors or in indoor locations where they are exposed to solar radiation or to solar radiation behind glass for long periods. It is therefore very important to determine the effects of solar radiation, heat, moisture and other climatic stresses on the colour and other properties of plastics. Outdoor exposures to solar radiation and to solar radiation filtered by window glass are described in ISO 877 (all parts).<sup>[1]</sup> However, it is often necessary to determine more rapidly the effects of radiation, heat and moisture on the physical, chemical and optical properties of plastics with artificial accelerated weathering or artificial accelerated irradiation exposures that use specific laboratory light sources. Exposures in these laboratory devices are conducted under more controlled conditions than found in natural environments and are intended to accelerate eventual polymer degradation and product failures.

Relating results from accelerated weathering or artificial accelerated irradiation exposures to those obtained in actual-use conditions is difficult because of variability in both types of exposure and because laboratory tests never reproduce exactly all the exposure stresses experienced by plastics exposed in actual-use conditions. No single laboratory exposure test can be specified as a total simulation of actual-use exposures.

The relative durability of materials in actual-use exposures can be very different depending on the location of the exposure because of differences in UV radiation, time of wetness, temperature, pollutants and other factors. Therefore, even if results from specific accelerated weathering or artificial accelerated irradiation exposures are found to be useful for comparing the relative durability of materials exposed in a particular outdoor location or in particular actual-use conditions, it cannot be assumed that they will be useful for determining the relative durability of materials exposed in a different outdoor location or in different actual-use conditions.



# Plastics — Methods of exposure to laboratory light sources —

## Part 1: General guidance

### 1 Scope

This part of ISO 4892 provides information and general guidance relevant to the selection and operation of the methods of exposure described in detail in subsequent parts. It also describes general performance requirements for devices used for exposing plastics to laboratory light sources. Information regarding performance requirements is for producers of artificial accelerated weathering or artificial accelerated irradiation devices.

**NOTE** In this part of ISO 4892, the term “light source” refers to radiation sources that emit UV radiation, visible radiation, infrared radiation or any combination of these types of radiation.

This part of ISO 4892 also provides information on the interpretation of data from artificial accelerated weathering or artificial accelerated irradiation exposures. More specific information about methods for determining the change in the properties of plastics after exposure and reporting these results is given in ISO 4582.

### 2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 291, *Plastics — Standard atmospheres for conditioning and testing*

ISO 293, *Plastics — Compression moulding of test specimens of thermoplastic materials*

ISO 294-1, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 1: General principles, and moulding of multipurpose and bar test specimens*

ISO 294-2, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 2: Small tensile bars*

ISO 294-3, *Plastics — Injection moulding of test specimens of thermoplastic materials — Part 3: Small plates*

ISO 295, *Plastics — Compression moulding of test specimens of thermosetting materials*

ISO 2818, *Plastics — Preparation of test specimens by machining*

ISO 3167, *Plastics — Multipurpose test specimens*

ISO 4582, *Plastics — Determination of changes in colour and variations in properties after exposure to daylight under glass, natural weathering or laboratory light sources*

ISO 4892-2, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps*

ISO 4892-3, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps*

ISO 4892-4, *Plastics — Methods of exposure to laboratory light sources — Part 4: Open-flame carbon-arc lamps*

ISO 9370, *Plastics — Instrumental determination of radiant exposure in weathering tests — General guidance and basic test method*

### 3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

NOTE Definitions of other terms that are related to weathering tests are found in Reference [2].

#### 3.1 control

<weathering testing> material which is of similar composition and construction to the test material and which is exposed at the same time for comparison with the test material

Note 1 to entry: An example of the use of a control material would be when a formulation different from one currently being used is being evaluated. In that case, the control would be the plastic made with the original formulation.

#### 3.2 file specimen

portion of the material to be tested which is stored under conditions in which it is stable and which is used for comparison between the exposed and unexposed states

#### 3.3 artificial accelerated weathering

exposure of a material in a laboratory weathering device to conditions which may be cyclic and intensified compared with those encountered in outdoor or in-service exposure

Note 1 to entry: This involves a laboratory radiation source, heat and moisture (in the form of relative humidity and/or water spray, condensation or immersion) in an attempt to produce more rapidly the same changes that occur in outdoor exposure.

Note 2 to entry: The device may include means for control and/or monitoring of the light source and other weathering parameters. It may also include exposure to special conditions, such as acid spray to simulate the effect of industrial gases.

#### 3.4 artificial accelerated irradiation

exposure of a material to a laboratory radiation source intended to simulate window-glass-filtered solar radiation or radiation from interior lighting sources and where specimens may be subjected to relatively small changes in temperature and relative humidity in an attempt to produce more rapidly the same changes that occur when the material is used in an indoor environment

Note 1 to entry: These exposures are commonly referred to as fading or lightfastness tests.

#### 3.5 reference material

material of known performance

#### 3.6 reference specimen

portion of the reference material that is to be exposed

### 4 Principle

#### 4.1 General

Specimens of the samples to be tested are exposed to laboratory light sources under controlled environmental conditions. The methods described include the requirements which have to be met for

the measurement of the irradiance and radiant exposure in the plane of the specimen, the temperature of specified white and black sensors, the chamber air temperature and the relative humidity.

## 4.2 Significance

**4.2.1** When conducting exposures in devices that use laboratory light sources, it is important to consider how well the accelerated-test conditions simulate the actual-use environment for the plastic being tested. In addition, it is essential to consider the effects of variability in both the accelerated test and actual exposures when setting up exposure experiments and when interpreting the results from artificial accelerated weathering or artificial accelerated irradiation exposures.

**4.2.2** No laboratory exposure test can be specified as a total simulation of actual-use conditions. Results obtained from artificial accelerated weathering or artificial accelerated irradiation exposures can be considered as representative of actual-use exposures only when the degree of rank correlation has been established for the specific materials being tested and when the type and mechanism of degradation are the same. The relative durability of materials in actual-use conditions can be very different in different locations because of differences in UV radiation, time of wetness, relative humidity, temperature, pollutants and other factors. Therefore, even if results from a specific exposure test conducted in accordance with any of the parts of this International Standard are found to be useful for comparing the relative durability of materials exposed in a particular environment, it cannot be assumed that they will be useful for determining the relative durability of the same materials in a different environment.

**4.2.3** Even though it is very tempting, it is invalid to assign to all materials a “general acceleration factor” relating “x” hours or megajoules of radiant exposure in an artificial accelerated weathering or artificial accelerated irradiation exposure to “y” months or years of actual exposure. Such acceleration factors are invalid for the following reasons.

- a) Acceleration factors are material-dependent and can be significantly different for each material and for different formulations of the same material.
- b) Variability in the rate of degradation in both actual-use and artificial accelerated weathering or artificial accelerated irradiation exposures can have a significant effect on the calculated acceleration factor.
- c) Acceleration factors calculated based on the ratio of irradiance between a laboratory light source and solar radiation (even when identical passbands are used) do not take into consideration the effects of temperature, moisture and differences in relative spectral irradiance between the laboratory light source and solar radiation.

**NOTE** Acceleration factors determined for a specific formulation of a material are valid, but only if they are based on data from a sufficient number of separate exterior or indoor environmental tests and artificial accelerated weathering or artificial accelerated irradiation exposures so that results used to relate times to failure in each exposure can be analysed using statistical methods. An example of a statistical analysis using multiple laboratory and actual exposures to calculate an acceleration factor is described in Reference [3].

**4.2.4** There are a number of factors that may decrease the degree of correlation between accelerated tests using laboratory light sources and exterior exposures (more specific information on how each factor may alter the stability ranking of materials is given in [Annex B](#)):

- a) the differences in the relative spectral irradiance of the laboratory light source and solar radiation;
- b) the irradiance levels higher than those experienced in actual-use conditions;
- c) the exposure cycles that use continuous exposure to radiation from a laboratory light source without any dark periods;
- d) the specimen temperatures higher than those in actual conditions;